The success story of self-extinguishing steel cord conveyor belts in German underground coal mining is making coal miners from other countries take note as regulations there become stricter. Bernd Küsel, of German-based Phoenix, describes these successes.

Putting out the fire

[Image of a coal mine with a worker]
Between 1960 and 1972, 131 conveyor belt related fires were recorded in West Germany. As a result, the German mining authorities condemned the use of the conveyor belts used in the mines, which were designed to be fire resistant and anti-static. These belts, which were designed to German Industry Standards (DIN) at the time, were believed to actually aid the spread of fire over long distances.

Consequently, in 1975 the German mining authorities implemented new requirements for steel cord conveyor belts (DIN 22100). These new regulations demanded that the new conveyors were subjected to the most stringent tests. These included:

- A specially prepared 2m long sample is exposed to the flames of a large propane burner. After the test, a part of the belt sample has to be intact across the whole width.
- An 18m long full belt width sample is tested in a real underground fire environment and the belt must not be burning 10m away from the fire.
- During the fire, fumes must be minimal and the inhaling resistance of a filter self-rescuer must not increase by more than 5Nbar during the smoulder pot test.
- The surface resistance must be at least 1.2kN/m.
- The lowest oxygen index which is used as a method of identifying a conveyor belt’s fire behaviour (DIN 22117).

With these regulations in place all the existing underground steel-cord conveyor belts had to be replaced within a specified time with the new so-called self-extinguishing types (DIN 22129).

This article describes the performance of such high strength steel cord conveyor belts to date.

The first one

The world’s first self-extinguishing steel cord conveyor belt was 3000m long and 1400mm wide, type Phoenocord St 4000. It was commissioned in 1976 in Saarberg’s Göttingen underground mine in South West Germany. Göttingen produces approximately 2Mt of hard coking coal per year.

The 28mm thick conveyor belt with Phoenotec synthetic single cord reinforcement is operating on a slope conveyor with a lift of 300m. After 12 years of operation, a length including a splice was taken from this belt for comprehensive testing. The overall results were excellent: the fire behaviour was unchanged and the technical data was within the requirements for the new conveyor belt.

In 1993, after 16 years of operation and 4Mt of conveyed coal, the same procedure was repeated. Again, the test results were within the original range. The rubber cover wear was a mere 1-2mm.

The others

In the period between 1979 and 1983, three 5000kN/m belts went into service in coal mines using slope conveyors with lifts varying from 200 to 400m.

A 3800m long and 1400mm wide conveyor belt, the Phoenocord St 4500 with 16mm plus 8mm covers including Phoenotec reinforcements, carries coal over a conveying lift of 349m in the so-called Barbarastollen. It was commissioned in January 1978 at Saarberg’s Emsdorf mine which produces around 2.5Mta of hard coking coal. After 20 years the conveyor belt and all of its original splices are still in operation.

In January 1979, 3300m of 1200mm wide Phoenocord St 5000 was commissioned at Ruhrkohle’s Friedrich Heinrich mine, which produces over 3.5Mta of coking coal. This belt conveys run-of-mine coal over a lift of 390m. The Phoenocord conveyor belt including all of its original splices is still in good condition. No downtime caused by problems with either the conveyor belts or their splices has ever occurred.

The strongest one

The strongest conveyor belt on earth is a Phoenocord St 7500 operating at Ruhrkohle’s Prosper Haniel mine. The actual conveyor belt strength is 8200N/m. The diameter of the 72 steel cords is 12.5mm giving an elastic modulus of 500kN/mm.
To drive such a large conveyor belt obviously requires an extremely powerful drive. The drive’s mechanical attributes are outlined below:

- **Drive layout**: 1 head pulley
- **Pulley diameter**: 2,200 mm
- **Installed motor power**: 2 x 3100kW
- **Type of motor**: 3-phase current synchronous
- **Rated moment**: 631kNm
- **Maximum start-up torque**: 820 kNm
- **Rotor weight**: 20t
- **Stator weight**: 25.5t
- **Shaft diameter**: 900mm

### Conveyor belt construction

A Phoenotec conveyor belt based on DIN 22129 is a complex construction consisting of:

- open stranded fire-zinc coated steel cords
- polychloroprene rubber based wearing covers
- special core adhesion rubber
- single synthetic cord transverse reinforcement.

The conveyor belt must have the greatest possible wear and damage resistant properties, in addition to having the inherent characteristics of resisting the influence of mine water and other operating hazards, thus maintaining other safety and performance standards.

All material—elastomers and polymers—must have adequate fatigue strength. Polychloroprene rubber (CR), as one of the main ingredients in self-extinguishing steel cord conveyor belts, offers fire safety advantages and a high resistance to ageing. In the case of the formerly used flame resistant grades, which were based on styrene-butadiene rubber (SBR), fire retardants had to be added.

The weakest point in a conveyor belt is the joint. The field splices must achieve the same service life as the belt itself. For this reason all of the high-strength steel cord conveyor belts in German underground mining were made under Phoenix supervision, with Phoenix splicing material or using Phoenix splice designs.

More than 20 years of practical performance of the conveyor belts and their splices show that it was a good decision by the German mining authorities to implement the present strict requirements. With mining regulations becoming stricter in many other countries Phoenix is well placed to provide a solution to the problems that this will bring.